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Utilizing the Platform Merdeka Mengajar in Elementary Schools: A Fundamental Effort for Learning Reform in Indonesia

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ABSTRACT

Technology for teachers has a strategic role in supporting the learning reform, and in Indonesia, this process is currently taking place through the PMM. Therefore, this research aims to describe aspects of PMM implementation in elementary schools and the learning reform after teachers utilize PMM? Qualitative descriptive methods were used in this study. The participants were 6 principals and 11 teachers from 6 elementary schools in Cluster XVI Region 3 Parepare City, South Sulawesi, Indonesia. Data were collected using interviews, observation, and documentation techniques. The research data were analyzed in three stages: data condensation, data display, and conclusions. The results showed that aspects of PMM implementation are school support, external support, teachers' learning collaboration, benefits, and barriers. The characteristics of learning after PMM implementation are the diversity of learning methods, utilization of technology in learning, application of differentiated learning strategies, application of project-based learning, diversity of learning media, and increased student engagement. Various changes in learning characteristics after using PMM indicate significant reforms in the quality of the learning process.

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Introduction

The Indonesian government has committed to encouraging the utilization of technology in the education sector as part of its innovation and transformation efforts in schools. The government strives to improve the quality of education in Indonesia and prepare young people who are ready to face challenges in the digital era. One of these commitments is through the Merdeka Belajar policy, one of the goals of which is through programs that create an educational ecosystem. Education that will be achieved will be more flexible and adaptive to technological developments. One example of a government program is the implementation of Platform Merdeka Mengajar (PMM) or Independent Teaching Platform, an educational platform that serves as a partner for teachers in learning and implementing the national curriculum (Merdeka/ Independent Curriculum) [1]. Since the beginning of 2025, it has been integrated into the Ruang Guru dan Tenaga Kependidikan (Ruang GTK) [2].

In order to accelerate the implementation of the Merdeka Curriculum, the Indonesian government, through the Ministry of Education and Culture (MOEC), needs a strategy to carry out training for teachers quickly and massively, provide learning resources, and provide innovative teaching tools for teachers. For this reason, PMM was built and implemented as one of the tools that can support the implementation of the Merdeka Curriculum in schools. In PMM, various features can help teachers understand, implement, and develop the Merdeka Curriculum. MOEC developed PMM to support teachers in implementing the Merdeka Curriculum at the education unit level. In addition, PMM also aims to assist teachers by providing references and inspiration and improving their understanding and skills in implementing the Merdeka Curriculum. All of this is done in the spirit of collaboration and knowledge-sharing among teachers. Since January 21, 2025, PMM has been integrated into the Platform Ruang GTK. Although PMM has transformed into Ruang GTK since January 21, 2025 [2], its function remains the same, namely to provide opportunities for educators to learn and hone their competencies without being limited by space and time. Ruang GTK is one of the technology platforms that is expected to accelerate the transformation of teacher competence in Indonesia [3]. This platform is provided for teachers and principals to support the learning process in the classroom. Ruang GTK serves as a source of learning materials, teaching resources, and references that can be adjusted to the needs of teachers or learning objectives to be achieved in the classroom. Utilization of the GTK space platform is a hope to develop teacher competence in carrying out their duties, especially regarding professional competence, because in utilizing this application, teachers will continue to pose with IT devices, and the ability to operate them so that it is hoped that the support of this platform can improve the

ability of teachers to operate and develop IT-based learning and make it easier for teachers to manage their professional duties [3].

Several previous studies have examined PMM and its implementation among teachers. For example, research explains that the transformation of education through technological innovations, such as PMM, requires attention to various aspects, including infrastructure, teacher training, learner response, and collaboration with parents [4]. To achieve a more holistic and inclusive education transformation, there needs to be continuous efforts to improve teachers' competencies, support learners psychosocially, involve parents, and address the digital divide. In subsequent research, raise the issue of PMM's effective adoption process to support the implementation of the Merdeka Curriculum [5]. The conclusion is that PMM is an effective medium in supporting the implementation of the Merdeka Curriculum. However, its success depends heavily on how well teachers can access and use the platform. The use of PMM features, such as self-training and learning communities, can improve teacher competence and the quality of learning in schools. However, there is still room for improvement in its utilization. Other research explains that the implementation of PMM and its impact on teachers [6]. Overall, previous research shows that PMM is a very suitable tool to help teachers, especially in elementary schools, develop their abilities, innovation, and creativity[4], [6], [7], [8]. In this platform, there are various features designed to make it easier for teachers to find references, get new ideas, and deeply understand the Merdeka Curriculum that is being implemented. The more often teachers utilize and learn the features in it, the more new knowledge and skills they can gain. Therefore, optimal use of PMM is essential to improve the quality of teaching of teachers in elementary schools so that they can become more competent and creative educators in supporting the teaching and learning process in the classroom. Another study concluded that teachers lack the optimal utilization of technology in implementing the Merdeka Curriculum, even though PMM has been provided as a means to assist teachers [9].

Based on previous research studies that discuss PMM, there is limited specific research on the implementation aspects of using PMM among elementary schools and its impact on changes in classroom learning. In addition, previous research that specifically examines the implementation of PMM in schools in Parepare City, Indonesia, is still relatively limited. Thus, it is important to conduct further research that not only examines PMM for teachers but is also able to provide a comprehensive picture of the implementation aspects and the impact of the implementation of the platform on the dynamics and development of learning in schools. This research is expected to answer the following research questions. First, what are the aspects of PMM implementation in elementary schools in cluster XVI region 3 of Parepare City, Indonesia? Second, what is the learning that occurs in schools after teachers utilize PMM?

Material and Methods

A. Research Approach and Method

The approach used in this research is qualitative with descriptive methods. Qualitative research is a research process to understand human or social phenomena by creating a comprehensive and complex picture that can be presented in words, reporting detailed views obtained from informant sources, and conducted in a natural setting [10], [11], [12], [13], [14]. The researcher chose a qualitative approach with a descriptive method because this method allows researchers to explore data through an in-depth interview and observation process about the understanding and experience of elementary schools in using PMM, as well as examining the changes or learning transformation processes that occur in these schools. The research is conducted in a natural setting (naturalistic), not the result of treatment \or manipulation of the variables involved. Descriptive research is a research method that can describe the object or subject under study objectively [15]. The aim is to present facts systematically and accurately describe the characteristics of the object and frequency under study. In this case, to explore the experience of schools in Parepare City in using PMM, as well as to describe learning in elementary schools after they learn and utilize PMM.

B. Research Setting

This study was conducted in Cluster XVI Region 3, Parepare City, which included six elementary schools. The selection of this location was based on the consideration that this cluster consists of a combination of public and private schools, thus enabling the researcher to observe the implementation of PMM in a variety of diverse contexts. Since there are different types of schools, this study can provide a more complete picture of the use of PMM in various schools. The subjects of this study were principals and teachers at schools in the cluster where the implementation of PMM is considered good.

C. Sampling and Data Collection Procedure

This research uses a purposive sampling technique with a snowball sampling type to select informants. Purposive sampling is one of the non-random sampling techniques often used in experimental research [16]. In simple terms, the sampling and data collection procedures can be described in Fig. 1.

D. Data Source & Research Participants

There are two sources of research data, namely primary and secondary data. Primary data in this study were obtained through direct interviews with principals and teachers in 6 elementary schools in Cluster XVI Region 3, Parepare City. The principals provided administrative and policy views on the implementation of PMM.

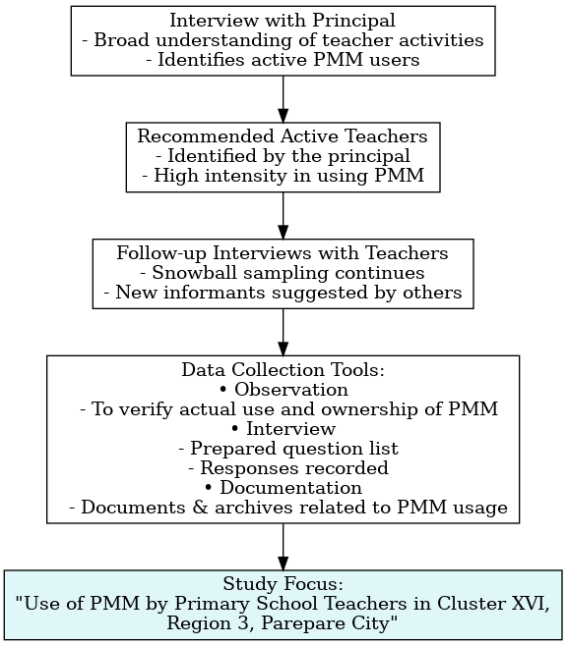


Fig. 1. Sampling and Data Collection Procedure

Teachers who have been actively using PMM were asked about their experiences in utilizing PMM and its implementation in their teaching and learning activities. Secondary data is obtained from various documents and previous research literature related to the use of technology in learning, especially related to the implementation of PMM. Table 1 and Table 2 summarizes the profiles of informants or participants in this study.

Table 1. Principal Research Informant Profile

No.	Principal Initials	Male/Female	Age (Years)	Last Education	Term of Office (Years)
1	KSA	Female	57	Post Graduate	6
2	KSB	Female	49	Post Graduate	3
3	KSC	Female	55	Graduate	1
4	KSD	Male	59	Graduate	2
5	KSE	Female	38	Post Graduate	3
6	KSF	Male	56	Post Graduate	2

E. Researcher Role

The researcher functions as the main instrument as well as the data collector, actively interacting with elementary school teachers to observe and understand the learning transformation process. The presence of researchers in the field is necessary to obtain in-depth and contextualized data. In qualitative research, the researcher's role is the primary key, so that the research conducted produces new findings or theories that can provide solutions to the problems faced, as well as answer the challenges of the times [17]. For this reason, in this study, the role of the researcher is that of a participant observer because the researcher is actively involved in the school environment while maintaining his leading role as a research observer.

Table 2. Teacher Research Informant Profile

No.	Teacher Initials	Male/Female	Age (Years)	Last Education	Length of Teaching (Years)
1	GHD	Female	29	Graduate	6
2	GMS	Male	34	Graduate	8
3	GBW	Female	41	Graduate	15
4	GRM	Female	39	Graduate	16
5	GNT	Female	40	Graduate	19
6	GYL	Female	41	Graduate	12
7	GLR	Female	37	Graduate	15
8	GDN	Female	31	Post Graduate	6
9	GAF	Female	34	Graduate	3
10	GUL	Female	30	Graduate	2
11	GYJ	Female	28	Graduate	4

F. Data Validity

In this research, the efforts made by researchers to obtain the validity of their findings involve the use of triangulation techniques. Triangulation is a method used by researchers to check and increase the validity of research by analyzing research questions from various perspectives [18]. To ensure the validity of the data, several triangulations will be used in this research. In practice, researchers do not only use one data collection method but combine three types of techniques at once. Data triangulation means using interviews, observation, and documentation techniques. In source triangulation, the researcher will compare data obtained from various parties, such as teachers and principals, to ensure consistency and correctness of information regarding the use of PMM. Meanwhile, in method triangulation, researchers will use various data collection techniques, such as interviews, observations, and documentation, to evaluate the suitability between the results of interviews and the reality of PMM implementation in the classroom. The use of these two types of triangulations is expected to help researchers obtain more valid and comprehensive data related to the form of PMM use in schools and its impact on teachers in the learning process.

G. Data Analysis

The data analysis process is carried out in a structured manner using interview transcripts, field observation notes, questionnaires, and other materials to map and present the results of this study. In order for the results of descriptive research to be clear and precise, the data needs to be analyzed in a coherent and directed manner. In qualitative data analysis, there are several important stages through three streams of activities that take place simultaneously, namely data condensation, data presentation, and conclusion drawing/verification [19]. In simple terms, the data analysis procedures can be described in Fig. 2.

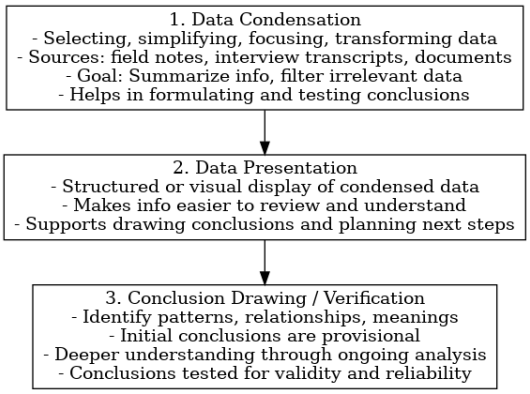


Fig. 2. Data Analysis Procedure

H. Fulfillment of the Research Ethics Code

In accordance with the code of ethics in research, the participants of this study were interviewed, observed, and documented with the consent of each participant. However, school names and individual teacher names are presented in the form of initials. This is also in accordance with the request of the majority of the participants of this study, so the researcher is obliged to respect the participants' privacy.

Results

The results of this research attempt to answer the following questions: What are the aspects of PMM implementation in elementary schools in cluster XVI region 3 of Parepare City? Moreover, how does learning occur in schools after teachers utilize PMM? The research data below will be explained based on the structure of the research questions. In accordance with the code of ethics in research, school names and individual teacher names are presented in the form of initials. This is also in accordance with the request of the majority of participants in this study, so the researcher is obliged to respect the participants' privacy.

A. Implementation Aspects of Using PMM in Elementary Schools

The data findings show several aspects of the implementation of PMM use in elementary schools (SDN). They are school support, external support, collaboration, benefits, and barriers. The following is a description of the data for each aspect, as well as a summary and some documentation, which can be seen in Fig. 3 and Fig. 4.

The first data finding is that school support for PMM use is reflected in the various efforts made to facilitate teachers' access to and use of this platform. The code findings in this study are explained in Table 3.

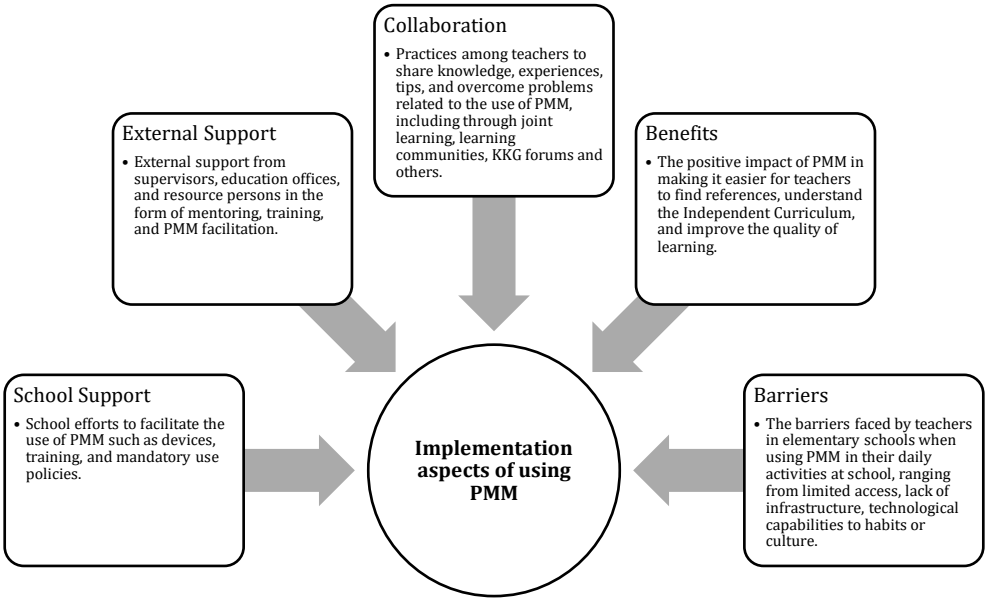


Fig. 3. The Key Findings: Implementation Aspects of Using PMM



Fig. 4. Teachers are Accessing PMM in the School

Table 3. Summary of Data Findings on the Category of School Supports

	Summary
Example of participant response	• "The school tries to facilitate by providing devices such as computers, laptops, or tablets to support the use of PMM." (GYL, SDN C) • "Wi-Fi network for teachers so they can easily access." (SLA, SDN B) • "This training can be done in the format of workshops, seminars, or training classes." (KSC, SDN C) • "Schools require teachers to use PMM to develop lesson plans, teaching modules, and assessments. Teachers are given targets for using certain features, such as completing self-training modules or uploading good practices on the platform." (KSA, SDN A) • "There is a learning community where teachers help each other in implementing PMM." (KSB, SDN B) • "Every Thursday, there is a special meeting to discuss PMM." (KSF, SD F)
Code	• providing facilities • internal school policies • training or workshops • regular meetings and socialization
Category	School support
Themes	Implementation aspects of using PMM

The second data finding is that support from external parties, such as supervisors and education offices, plays an important role in assisting teachers during the PMM implementation process. The code findings in this study are explained in Table 4.

Table 4. Summary of Data Findings on the Category of External Supports

	Summary
Example of participant response	• "The education office plays a role in socializing PMM and the education supervisor plays a role in providing direct assistance to teachers." (KSA, SDN A) • "There are facilitators from the education office who hold workshops " (GHD, SDN A) • "Supervisors often provide support once a month." (GNT, SDN C) • "There are facilitators from the education office who provide technical guidance."(GYJ, SDN F) • "Supervisors often come to motivate the use of PMM."(KSD, SDN D) • "There are directions from the education office to download and utilize PMM." (GRM, SDN B)
Code	• program socialization • technical guidance • direct training • routine assistance
Category	External support
Themes	Implementation aspects of using PMM

The third data finding is that collaborative culture between teachers in using PMM is strong in various schools, which is demonstrated through mutual assistance and sharing of experiences. The code findings in this study are explained in Table 5.

Table 5. Summary of Data Findings on the Category of Collaborative

	Summary
Example of participant response	• "Yes, we help each other; fellow teachers at my school are very supportive in using PMM. We often share tips and experiences, especially on how to use teaching modules and independent training features." (GHD, SDN A) • "At school, yes, this is always monitored, motivation in using PMM. ... Every Tuesday we study together." (GMS, SDN A) • "Yes, it is very supportive because usually at school we get together. A kind of small study group where we collaborate to learn PMM."(GNT, SDN C) • "Sharing experiences about PMM in monthly meetings." (KSE, SD IT E) • "Supporting each other through KKG, sharing experiences using PMM.Small discussion groups discuss PMM." (GLR, SDN D)
Code	• informal discussions • small study groups • routine activities • monthly meetings
Category	Collaborative
Themes	Implementation aspects of using PMM

The fourth data finding, the PMM, provides various benefits for teachers in supporting learning in accordance with the spirit of the Merdeka Curriculum. Teachers feel various benefits from using the PMM, especially in terms of accessibility and ease of compiling learning materials. The code findings in this study are explained in Table 6.

Table 6. Summary of Data Findings on the Category of Benefits

	Summary
Example of participant response	• The existence of PMM very helps me because all the learning resources I need are in one place." (KSA, SDN A) • "PMM is very useful in helping me understand the Merdeka Curriculum more deeply." (GHD, SDN A) • "*In* PMM, there are teaching tools that can be directly adjusted to the needs of students." (GRM, SDN B) • "The teaching modules in PMM really help teachers who have difficulty finding teaching materials." (GYL, SDN C) • "There are inspirational videos that can be used as a guide." At the same time, GBW from SDN B emphasized."(GNT, SDN C) • "PMM can be an inspiration in teaching." (GAF, SD IT E)
Code	• access integrated learning resources • simplify the learning planning process • enrich teaching strategies • encourages teachers to self-reflect and innovate
Category	Benefits
Themes	Implementation aspects of using PMM

The fifth data finding is that although PMM offers various benefits, teachers face a number of barriers that hinder its optimization. In its implementation, teachers face various technical and non-technical barriers that hinder the optimal use of PMM. The code findings in this study are explained in Table 7.

Table 7. Summary of Data Findings on the Category of Barriers

	Summary
Example of participant response	• ″The internet connection at school is often unstable, which makes it difficult for me to access some features in PMM.″ (KSA, SDN A) • ″Senior teachers are less familiar with technology.″ (GBW, SDN B) • ″Time issues make it difficult to divide between administrative tasks and the use of PMM.″ (KSB, SDN B) • ″PMM is heavy, because you have to watch videos and there are a lot of administrations.″ (KSF, SD F)
Code	• unstable internet networks • the absence of digital devices • power outages • lack of understanding of technology • large amount of content • takes up time • administrative demands
Category	Barriers
Themes	Implementation aspects of using PMM

B. Learning Characteristics in Elementary Schools After Implementing PMM

Data findings show that there are several characteristics of learning in elementary schools after implementing PMM. The following is a description of the data for each characteristic, while the summary and some documentation can be seen in Fig. 5 and Fig. 6.

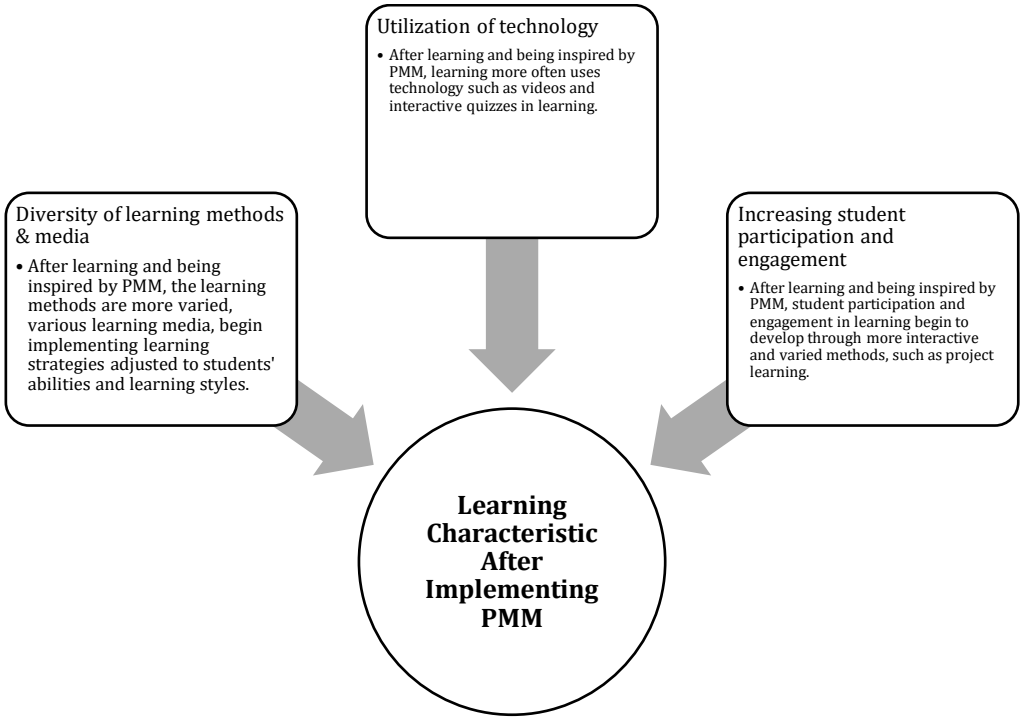


Fig. 5. The Key Findings Learning Characteristic after Implementing PMM



Fig. 6. The Process of Implementing Teacher Learning Outcomes in PMM

The first data finding was that after implementing PMM, teachers in elementary schools in Cluster XVI of Parepare City began to develop more varied learning methods. This method transformation shows a shift from a teaching paradigm to a more dynamic and inclusive learning paradigm. The code findings in this study are explained in Table 8.

Table 8. Summary of Data Findings on the Category of Diversity of Learning Methods

	Summary
Example of participant response	• "Before using PMM, classroom learning tended to be more conventional with lecture methods. However, after using PMM, teachers utilize interactive quizzes that make students more involved in the material." (KSA, SDN A) • "The teaching modules in PMM make it easier for me to design interesting and relevant project-based learning." (GHD, SDN A) • "The teaching module in PMM makes it easier for me to design interesting project-based learning." (GHD, SDN A) • "Students become more active in asking questions and discussing while working on projects." (GYL, SDN C) • "Project-based learning makes students more creative and proactive." *(GAF, SDN A)* • "Learning is now more interactive with videos and quizzes that students can directly access." (GYL, SDN C) • "Before using PMM, we used more textbooks. Now, it is more varied; we use videos and PowerPoint slides more often." (GNT, SDN C) • *"Learning media is more diverse with the interactive modules, such form Canva or PowerPoint, I learn from PMM."* (GUL, SD IT E) • "We use differentiated learning strategies from PMM, which encourage students to complete tasks according to their respective abilities." (GHD, SDN A) • "The initial assessment helps us adjust the material to the student's abilities." (KSD, SDN D) • "Grouping students based on *diversity of students,* such as learning styles, makes them more comfortable in learning." (GRM, SDN B) • "The use of different formative assessments from PMM makes it easier for us to evaluate student development."(GNT, SDN C)
Code	• project-based learning methods • technology-based learning approaches
Category	Diversity of learning methods& media
Themes	Learning characteristics after implementing PMM

The second data finding is that one of the real impacts of the implementation of PMM is the increasing intensity of technology use in learning activities. This innovation strengthens the principle of digital learning (digital pedagogy), which emphasizes the use of technology to improve students' understanding and skills independently. See Table 9.

Table 9. Summary of Data Findings on the Category of Utilization of Technology

	Summary
Example of participant response	• "Teachers now use interactive quizzes in PMM to test students' understanding after each lesson." (KSB, SDN B) • "The use of educational videos from PMM makes it easier for students to understand the material." (GAF, SD IT E) • "The use of learning modules by PowerPoint and Canva, inspired by PMM, makes the material more interesting." (GYJ, SDN F) • "Learning is now more interactive with videos and quizzes that students can directly access." (GYL, SDN C) • "Learning media is more diverse with the interactive modules, such form Canva or PowerPoint, I learn from PMM." (GUL, SD IT E)
Code	• digital quizzes • instructional videos • interactive modules
Category	Utilization of technology
Themes	Learning characteristics after implementing PMM

The third data finding, after the teacher implemented the inspiration from PMM, encouraged the growth of student participation and involvement in the learning process. This increase reflects the active learning approach, which places students as the main subjects in the learning process. The code findings in this study are explained in Table 10.

Table 10. Summary of Data Findings on the Category of Increasing Student Participation and Engagement

	Summary
Example of participant response	• After implementing learning inspiration from PMM, the methods and media are more varied so that students are more active in asking questions and discussing." (GRM, SDN B) • "The interactive quizzes obtained from studying at PMM make students more motivated to learn." (KSA, SDN A) • "The use of educational games inspired by PMM makes students more enthusiastic about learning." (GYL, SDN C) • "The P5 Project Inspiration from PMM makes students more courageous in expressing their opinions." (GUL, SD IT E)
Code	• active in discussing • asking questions • showing initiative • courage in expressing opinions
Category	Increasing student participation and engagement
Themes	Learning characteristics after implementing PMM

Discussions

A. Implementation Aspects of the Use of PMM in Elementary Schools

1. School Support

The results of interviews with principals and teachers at elementary schools in Cluster XVI Region 3 Parepare City revealed that support from the school played a vital role in implementing PMM. School support is a key factor in ensuring the successful implementation of the PMM in the elementary school environment. This support includes providing facilities such as digital devices (laptops, computers, tablets), internet networks, internal school policies that require the use of PMM, and conducting training or workshops to increase teacher capacity. In addition, schools have learning communities that actively discuss and assist teachers in using PMM. Regular meetings and socialization are an important part of this support system.

This finding is in line with a research conclusion that the role of the principal greatly determines the quality of education [20]. The support of the principal, such as giving trust to teachers, coaching the quality of educators, and good internal school management, also contributes directly to improving the quality of implementation of educational programs. If the principal is passive, teachers will feel burdened. However, a proactive principal can create a collaborative learning climate. Meanwhile, other research shows that coaching-based academic supervision by the principal can help teachers identify potential, design

creative learning, and improve professional competence [21]. The principal in this role becomes a facilitator and motivator to encourage teachers to innovate, which is very important in supporting digital transformation, such as PMM. In addition, the principal's visionary leadership encourages the formation of a collaborative, adaptive, and innovative organizational culture, which is very appropriate for implementing PMM as a form of digital transformation in education [22]. Therefore, the support of a visionary, communicative principal who can build an internal support system is a key factor in the success of teachers in utilizing PMM optimally.

2. Outside Support

Support from external parties, especially the Education Office and school supervisors, played a significant role in implementing PMM at SD Cluster XVI Region 3 Parepare City. Based on interviews with the principal and teachers, it was found that the Education Office provided training, technical assistance, and regular information updates related to PMM features. the implementation of PMM does not only rely on internal school support but also relies heavily on support from external parties such as supervisors, education offices, and external facilitators. This support is realized in the form of program socialization, technical guidance, direct training, and routine assistance. The role of supervisors who actively visit schools and provide motivation is one of the important indicators of the sustainability of educational innovation. External support also illustrates that teachers are not alone in making changes, thus building self-confidence and legitimacy in the use of PMM as a national learning platform for teachers. This study reveals that the acceleration of technology at the school level is greatly influenced by structural readiness facilitated by the Education Office and local government, including the availability of belajar.ID accounts, implementative training, and supervision. This study found that schools that received assistance from supervisors and the Office experienced higher acceleration in using PMM than schools that were not intensively assisted.

A research conclusion stated that collaboration between external parties (such as supervisors, mentors, and students) can strengthen the implementation of PMM-based literacy and numeracy [23]. Mentoring carried out by students and supervisors also helps overcome the technical limitations of teachers while providing strong moral encouragement to explore digital platforms. Then, in a study on public service innovation, stated that the success of bureaucracy-based technological innovation is determined by five elements, one of which is the active "engagement of external stakeholders" [24]. This aligns with the importance of partnerships between schools and the Education Office in supporting the success of educational innovations such as PMM. Overall, the active

engagement of the Education Office and school supervisors through mentoring, training, and technical supervision is an external foundation that accelerates school adaptation to digital systems and ensures the continuity of PMM implementation.

3. Teacher Learning Collaboration

The interview results showed that SD Cluster XVI Region 3 Parepare City teachers have formed a good collaborative culture in cooperative learning. Collaborative learning between teachers is an important practice in the process of adopting and adapting PMM in schools. Teachers share experiences, strategies, and solutions to technical barriers they face. These collaborative activities can take the form of informal discussions in the teacher's room, small study groups, routine activities such as KKG, or monthly meetings between teachers. This concept reflects the importance of learning communities in the world of education, where teachers learn together to improve their teaching practices. The learning community encourages joint reflection and improvement of pedagogical competence through collegial interaction. In the context of PMM, this collaboration helps teachers master the platform features more quickly and apply them contextually in their respective classes. In addition, this activity strengthens teachers' professional solidarity and becomes a space for learning innovation based on real needs in schools.

This practice is further strengthened by research conclusions that learning community activities can improve teachers' ability to understand new policies, such as the Merdeka Curriculum and PMM [25]. In this study, discussions, joint training, and sharing between teachers effectively improve understanding and confidence in using digital platforms. Teachers are also more open to asking questions and learning from each other in a collaborative atmosphere. Furthermore, collaborative approaches between teachers must be continuously strengthened in professional development, collaboration has been proven to help teachers share solutions when facing various barriers in digital learning [26]. This has also had an impact on increasing teacher skills in compiling teaching materials that are relevant to student characteristics. In the context of PMM, collaborative learning is essential so that teachers do not feel alone.

Besides that, collaboration between teachers at the elementary school level greatly supports the creation of a learning culture that aligns with digitalization [27]. When teachers exchange experiences regarding the use of PMM, the learning process becomes more open and faster. This also accelerates teachers' understanding of the features of PMM, such as independent training and lesson plans. Therefore, learning collaboration between teachers in schools strengthens understanding of PMM and creates a mutually supportive and encouraging work environment in facing the dynamics of learning changes.

4. Benefits of PMM

Based on the SD Cluster XVI Region 3 Parepare City study results, teachers and principals agreed that PMM provides many benefits in the learning process. Teachers find it easy to access integrated learning resources, such as teaching modules, assessments, inspirational videos, and independent training that improve professional competence. PMM helps teachers simplify the learning planning process and enrich teaching strategies through various contextual and practice-based references. Furthermore, the existence of interactive features encourages teachers to reflect on themselves and innovate in their teaching practices. However, these benefits tend to be felt more by teachers than by students, indicating the need to optimize PMM from a learning perspective that has a direct impact on students.

Teachers feel helped by PMM because the features, such as independent training, student assessments, and inspirational videos, are relevant and easy to access [8]. PMM also improves the quality of learning planning and implementation because teachers can obtain teaching materials and references at any time. PMM is also considered practical because it can be accessed through a belajar.id account is free of charge. Furthermore, research examined the benefits of PMM in improving teachers' digital competence at an elementary school [28]. The research concluded that teachers felt that PMM helped them prepare to teach in the digital era. However, this study also highlighted the need for assistance for teachers who are not yet familiar with technology. This aligns with conditions in the field, where several teachers in Parepare said they still experience barriers in accessing PMM optimally, mainly due to network limitations. Meanwhile, another study shows that after participating in PMM training, elementary school teachers feel more confident in utilizing the application [29]. The features offered by PMM are very supportive of implementing learning through the Independent Curriculum. Teachers obtain learning resources and can see examples of good practices from other schools through videos on PMM. Therefore, PMM provides tangible benefits for elementary school teachers by providing teaching materials, developing independent competencies, and increasing collaboration between teachers.

5. Barriers

Based on interview data from six elementary schools in Cluster XVI Region 3 Parepare City, it was found that teachers faced several technical barriers in implementing PMM. The most common barriers include infrastructure limitations such as unstable internet networks, the absence of digital devices, and power outages in several schools. In addition, some teachers experience difficulties due to a lack of understanding of technology, especially senior teachers who are not familiar with digital platforms. Time issues are also

a significant obstacle, where teachers must divide their attention between administrative tasks and exploration of fairly complex PMM features. Several teachers complained about the large amount of content, such as training videos, that takes up time, as well as the administrative demands on the platform.

This finding aligns with the research results that teachers face barriers such as a lack of technical training, unstable internet connection, and limited supporting facilities, such as laptops and projectors [30]. This study highlights that these limitations cause the implementation of PMM to be less than optimal, especially in areas that do not yet have adequate digital infrastructure. Meanwhile, other research also revealed that the main challenge in teachers' use of PMM is the mismatch between teacher needs and the training content provided [31]. In addition, the lack of integration between PMM and the local curriculum makes teachers work twice as hard in compiling teaching materials. This condition can increase the workload, as conveyed by the principal of SDN F (KSF) in an interview, that the administration and videos in PMM feel quite burdensome and time-consuming. Other research shows that teachers have different levels of digital resilience, depending on age and experience [32]. Younger teachers generally master PMM faster, while more senior teachers require more time and additional training. This adjustment is essential to ensure all teachers can access and utilize PMM equally. Therefore, technical barriers such as unstable internet connections, lack of supporting facilities, and limited technological literacy are the main challenges in implementing PMM at the elementary school level, which need more attention from various parties. Differences in the ability to master technology are a challenge in the field. Therefore, fair and sustainable support is necessary so all teachers can progress together using PMM.

B. Learning in Elementary Schools After Teachers Implement the Use of PMM

1. Diversity of Learning Methods & Media

The results of interviews with teachers at SD Cluster XVI Region 3 Parepare City show that learning methods have become more diverse since teachers began accessing and adapting materials from PMM. The implementation of project-based learning increased after teachers started using PMM. GHD from SDN A stated that the PMM teaching module helped him design more interesting and relevant project learning. Meanwhile, GUL and GAF from SDIT E stated that the PMM P5 Project encouraged students to be more active in working together, being creative, and showing initiative. At SDN C, teacher GYL said that students became more active in asking questions and discussing, and GNT added that technology-based projects also strengthened students' digital skills. Although teachers' understanding of P5 is still moderate, the use of PMM has excellent potential to improve knowledge and effectiveness in implementing project learning in elementary schools

because it can be accessed flexibly as a means of teacher training [33]. In addition, implementing project-based learning models can significantly improve critical thinking skills and student engagement in class [34].

The diversity of learning methods has been proven to impact student learning positively. Various methods can improve students' learning readiness and engagement in the learning process compared to single methods, such as lectures [35]. This aligns with the practices of Parepare teachers, who often use practice-based methods and direct interaction. Through the analysis of the effectiveness of digital learning multimedia in elementary schools, concluded that the early introduction of digital media positively impacts students' readiness to face the digital era and improves the quality of learning [36]. The importance of various learning media in creating an engaging and effective learning atmosphere [37]. It encouraged prospective elementary school teachers to continue developing their abilities using various innovative learning media.

After participating in PMM, teachers in Cluster XVI began implementing differentiated learning strategies. This strategy allows teachers to adjust learning materials, processes, and products based on students' learning readiness, interests, and learning profiles. By learning from PMM, teachers are increasingly aware of the importance of accommodating the diversity of students in the classroom, both in terms of academic ability and learning style. Differentiated learning strategies can significantly improve students' reading comprehension [38]. In addition, the differentiation approach, combined with project-based learning, positively impacts students' collaborative skills [39].

2. Utilization of Technology in Learning

Based on the results of observations and interviews, teachers at SDN A have begun to apply technology in learning activities. Teacher GHD utilizes teaching modules from PMM and uses Chromebooks in the learning process, which also supports the creation of a collaborative learning atmosphere. Teachers not only use technology as a visual aid but also integrate it into active learning strategies such as digital quizzes, instructional videos, and interactive modules. PMM provides various features that can be used to enrich the learning process, including learning videos and interactive applications that students can access both at school and at home. PMM also supports the improvement of teachers' digital competence and encourages the effective use of technology in the preparation and delivery of digital teaching materials in elementary schools [28]. In addition, the digital resilience of elementary school teachers in using PMM shows that young teachers tend to be more active and creative in utilizing various digital platforms, such as webinars, learning videos, and other technology-based media [32].

3. Increasing Student Participation and Engagement

After accessing and utilizing PMM, Cluster XVI Region 3 Parepare City teachers began to feel increased student participation and engagement during the learning process. This is indicated by students who are more active in discussing, asking questions, and showing initiative and courage in expressing opinions. This involvement is triggered by more varied, interactive, and fun learning methods and media, such as the use of educational games, P5 projects, and interactive quizzes. The contribution of the Merdeka Curriculum and the Kampus Mengajar program to improving elementary school students' literacy and numeracy, active and innovative learning strategies, such as those available through PMM, contribute to increasing student engagement, both in and out of class [40].

Conclusion

Based on the results, several things can be concluded. First, implementing PMM has gone quite well with internal school support in providing facilities (devices, internet, learning communities) and policies encouraging the use of PMM. In addition, external support from supervisors and the education office also facilitated this implementation through training, mentoring, and workshops. Teachers actively collaborate, share experiences, and help each other understand the PMM features. Although the implementation has been positive, barriers such as limited internet connections, ICT skills of some teachers, and adaptation of the old curriculum are still challenges. Second, after implementing PMM, learning in SD Cluster XVI showed positive changes. Teachers began using more interactive, project-based methods, learning differentiation, and digital technology in the teaching process. Student activities became more active, creative, and collaborative, and there was an increase in learning motivation. Various changes in learning characteristics after using PMM indicate significant reforms in the quality of the learning process

The researcher conveys several recommendations based on the research results and conclusions. First, for schools, it is recommended to continue to encourage the optimization of PMM utilization through routine training, strengthening learning communities, and providing supporting facilities such as digital devices and adequate internet connections. Second, it is recommended that teachers continue to improve their digital and pedagogical competencies by utilizing various features available in PMM. Collaboration between teachers must also be enhanced to support the adaptation process to the Merdeka Curriculum more effectively. Third, the Education Office and supervisors can continue mentoring activities, monitoring, and providing an appreciation for the active engagement of teachers in the use of PMM. Different training approaches also need to be considered to suit the needs of each teacher. Fourth, for further researchers, it is recommended to expand the scope of research locations or focus more on certain aspects, such as the effectiveness of self-training features or the impact of PMM on

student learning outcomes, to enrich the literature related to the use of PMM in elementary education.

Conflict of Interest

The authors declare no conflict of interest.

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